

Editorials

Publishing Scientific Articles with Special Reference to LCA and Related Topics *

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1 A Short History of Scientific Publishing

Modern science was born in Europe at the end of the 16th and early 17th Century for unknown reasons and during a terrible time. The glorious Renaissance was over and religious fundamentalism, as we would say today, and the torture and public burning of so-called witches, was at its peak.

In contrast to the medieval science, which strongly relied on authorities (above all Aristoteles) and secretiveness, modern science is critical and non-religious (not antireligious; most pioneers believed in God and adhered to one of the Christian churches, e.g. Galilei, Kepler and Newton), experimental and empirical [1]. Theories have to be based on experiments, observations and mathematics, not on metaphysical concepts.

Scientific results were published in the form of books. The informal communication between scientists was performed using letters – until the advent of the E-mail¹. It is interesting to note that the than relatively young national languages started to replace the scholastic Latin in order to reach also the educated laypeople:

- Descartes: Latin + French
- Galilei: Latin + (Toscan) Italian
- Bacon, Newton: Latin + English
- Kepler: Latin + German (in popular publications only)

Most scientific pioneers of the 16th Century used Latin together with their native language. The situation is similar today: English, the Latin of our time, is preferred for international use and the national languages for the educated public at home or for topics of only regional interest.

The age of enlightenment, essentially the 18th Century, brought the scientific societies and the first scientific journals published by these 'academies'. The oldest scientific academies go back to the 17th Century, such as the 'accademia dei lyncei', Rome 1603 (Galileo Galilei was a member of this oldest scientific society), the 'royal society', London 1660, and the 'académie royale des sciences', Paris 1666².

The journals slowly started to replace books as the main medium for the communication of original research, a process which continued in the 19th Century and is nearly complete today³. The typical article in natural science is concise, as opposed to most works of social sciences and humanities⁴. This split can still be observed today.

The material basis of this new way of publishing was the invention of printing with movable letters around 1450 by Johannes Gutenberg⁵ [2]. The importance of this invention cannot be overestimated. It replaced the – beautiful, but expensive and rare – hand-written books. In the beginning, the printing of books was under control of the catholic church, but this control slowly vanished under the influence of the Protestant churches and the free cities, e.g. Basel and Amsterdam. There is a theory that printing, as the first modern communication technology, triggered the social revolution of the modern times [2]. I think that this may also be true for the advent of modern science, at least it was a decisive factor for the break-through of modern science and made the broad distribution of new ideas and knowledge possible.

2 The Importance of Publishing, Philosophical Background

- The purpose of the prescientific publishing was to hide the essential points (e.g. how exactly to make gold)
- Modern science and publishing requires enough information to repeat experiments and to fully understand theories
- Falsification has to be possible in principle (Popper)
- Scientific fraud can be detected soon

There are other aspects of publishing which are related to epistemology, or: how can we find scientific truth? The old 'science' of the medieval age and prescientific publishing tried to hide the essential points, in a way similar to the modern patent literature. Such a behaviour is clearly unscientific. Modern science publishing requires enough details to allow the repetition of experiments and to fully understand theories.

According to Karl Popper [3], the falsification of hypotheses and theories has to be possible if they are to be scientific. This is an extraordinary insight into the nature of science and is complemented rather than disproved by other,

* This paper is based on a lecture presented at the PhD course: Bridging Environmental and Economic Assessments for Decision Support. Aalborg University (Denmark) September 15–20, 2006 [17]

¹ Of course, E-mails can be considered as a kind of electronically transmitted letter; the speed of communication is paid, however, by an evident loss in style and carefulness in the preparation of this type of ephemeral document.

² Preceded by an earlier (ca. 1640), loose circle of scientists and philosophers around Pascal and Descartes.

³ It is increasingly challenged, however, by direct publication in the internet.

⁴ In the German language, which is clearer in this respect, since Wissenschaft ('science') is divided into Naturwissenschaft (natural science) and Geisteswissenschaft (soft or humane sciences, although there is no simple translation for the latter term in English).

⁵ The art of printing has been known in China and South Korea since the 8th Century [2] but, in contrast to Europe, it did not cause a social revolution to occur there. Movable letters had been invented in Korea at about the same time as in Europe [2].

more sociological theories of modern science (e.g. by Thomas Kuhn [4]).

A more practical aspect of detailed publications is that scientific fraud can be detected rapidly. There are plenty of recent examples, especially in the modern, often overestimated fields of 'event- and show business' science.

3 The Special Role of LCA and Similar Assessment Tools: Can LCAs be falsified?

To conclude this historical-philosophical introduction with a provoking question: can LCA studies be falsified? Strictly following Popper [3], this means: is LCA an exact science? I would say, partly yes. Especially the inventory can be falsified, if the rules are taken into account.

But there are problems:

- Objectivity versus value choices
- Allocation, cut-off rules
- Choice of impact categories and indicator models
- Midpoint versus endpoint modelling

How to make LCA as scientific as possible?

A pragmatic solution for LCA – but not for related unstandardised methods – is strict adherence to the ISO standards of the 14040 series [5,6]. This makes different studies better comparable. It is said, however, in ISO 14040 (old [5a] and new [6a]) that, to a large extent, a specific study is determined by the first component of 'goal and scoping'. Only if goal and scoping is compatible, can two studies be compared! The 2nd and 3rd component [5b,c,6b], LCI and LCIA, have to be done according to the rules laid down in the first component.

The fourth component, Interpretation [5d,6b], is also important with regard to the scientific status of a particular LCA study: this is the place to critically discuss the mostly comparative results obtained and to estimate their uncertainty.

A critical review according to ISO 14040 [5a,6a] and 14044 [6b] further improves a study, removes serious errors and makes deceiving by means of comparative LCA studies much more difficult [7]. In this connection, it should be mentioned that the SETAC 'Code of Practice' of 1993 [8] and the following – now superseded – 'old' ISO standards [5] were already written under the impression of a considerable **misuse** of the method for marketing purposes in the late 1980s. These 'proto-LCAs' [9] were similar to modern LCIs and often contained a rudimentary impact assessment, the methods used by the individual research groups, however, varied considerably. The standards are therefore restrictive out of past experience. According to the revised ISO standards [6], an LCA study containing comparative assertions intended to be made public **shall** be reviewed according to the panel method with at least 3 panellists. The strong wording ('shall') indicates, how important this issue has been to the authors of the standards and that they did neither trust the objectivity of LCA, nor the honesty of the commissioners and practitioners.

Finally, the publication in a peer-reviewed journal constitutes a further hurdle against misuse of the method. Unfortunately, full publication of the data is often not possible due to confidentiality issues. The critical reviewers accord-

ing to ISO have to ask for the data and to do plausibility judgments, compare with their own experience, etc. Of course, major faults in the main structure are more easy to recognize than small errors in the data set. The peer reviewers of the journals cannot ask for the full details due to restrictions in time and confidentiality; they have to rely on the results of the study review (if there were any!) and on their experience. They can ask for details in doubtful cases, however, and reject the paper if no satisfactory answer is given by the author(s). Furthermore, methodological details, references, etc. reveal scientific quality or inadequacy of a paper. In that way, the referees and editors determine from day to day what 'scientific' means in a certain field. This fine-tuning may, in the long run, be equally important for the development of the method as the overarching concept of finding scientific truth [3,4], especially in borderline cases like LCA and other assessment tools, where subjectivity cannot be fully avoided [10].

4 Where to Publish LCAs?

4.1 Survey

Presently, there are four journals publishing LCA-studies on a regular basis:

- The International Journal of Life Cycle Assessment (ecomod)
- Journal of Industrial Ecology (MIT Press)
- Journal of Cleaner Production (Elsevier)
- Integrated Environmental Assessment and Management, IEAM (SETAC Press)

In addition, special case studies can be published in journals dealing with the product group studied. For instance, the monumental ECOSOL⁶ LCI-study of surfactants used in the manufacture of detergents has been fully published in a series of papers in 'Tenside, Surfactants, Detergents', including the report by the critical review panel [11]. In fact, this kind of publishing case studies is an excellent idea, since these journals are read by those people interested in the product group assessed!

Int J LCA is placed on the top of the list since it is the only journal devoted entirely to LCA [12] and closely related concepts like Life Cycle Management (LCM) [13]. Int J LCA is also the official journal of several national LCA-Societies and the associate journal of the UNEP/SETAC Life Cycle Initiative.

J Industrial Ecology covers a much broader topic, but LCA is perhaps the single most important method used, together with Material Flow Analysis (MFA). This Journal also accepts long and comprehensive articles. The Editor-in-Chief is Reid Lifset. It is also the official journal of the Society for Industrial Ecology (SIE).

LCA is the main topic of one section in J Cleaner Production. Former LCA section editors were Kim Christensen and Tomas Ekvall.

⁶ ECOSOL is a sector group of CEFIC, the European roof organization of the national chemical industry associations; this group, composed by the main European surfactant producers, acted as the commissioner and data-provider of the LCI study performed by Franklin Ass., Prairie Village, Kansas, USA.

IEAM, the second scientific SETAC journal, is still young and also accepts a broad spectrum of papers dealing with environmental assessment tools, methodologies and case studies. A few LCA-articles have already appeared, some of them longer than accepted by Int J LCA. SETAC members have free access to the electronic version, the printed journal is delivered on request for a moderate charge.

4.2 The Institute of Scientific Information

The Institute of Scientific Information (ISI) has been founded by the great scientific information researcher Eugene Garfield. ISI publishes the Current Contents. In contrast to the Chemical Abstract Service (CAS), not all journals are accepted by Current Contents and the ISI Citation Index. This index is not provided by abstracting services, e.g. the Chemical Abstract Service – CAS – operated by the American Chemical Society (ACS). It is the counting of quotations and the calculation of impact factors that makes ISI unique.

Acceptance of a journal by the 'ISI Science Citation Index Expanded' (or: Web of Science, or: Web of Knowledge) is the prerequisite to get assigned a first impact factor after a further three-year period. For Int J LCA, it took 5 years (1996–2000 inclusive) to be listed by ISI as the first environmental life cycle assessment journal. The reason for this long waiting time was that the theme does not belong to the available scientific categories within ISI. Therefore, ISI reviewed this journal carefully before listing it in the Citation Index Expanded. However, apart from that, all new journals are reviewed in terms of the regular appearance, the appropriate frequency as well as the scientific approach, contents and setting.

The impact factor of a journal is nothing mysterious. It is calculated on the basis of citations in the previous year to articles published two years before and the number of papers published during these two years in that journal. Therefore, it takes three years to calculate an Impact Factor, and another year to publish it in JCR (Journal Citation Reports), see the example from Int J LCA in Table 1.

The most recent impact factor of Int J LCA amounts to 1.483 (2005); it has a good position compared to other, mostly much older, journals of its class (in 2005, Int J LCA ranked as number 50 of 140 journals in terms of impact factors). J Cleaner Production had 0.832 in 2005. J Industrial Ecology will get its first Impact Factor in 2008 (to be published in

2009) and IEAM is waiting to be listed in the ISI Science Citation Index Expanded.

Beside the impact factor, the **Journal Immediacy Index** is worth mentioning, since this index can provide a useful perspective for comparing journals specializing in cutting-edge research, indicating how quickly articles are cited. This index is calculated by dividing the number of citations to articles published in a given year by the number of articles published in that year. Recently, the 2005 Journal Immediacy Index for Int J LCA can be calculated as 0.644. When compared with other journals, Int J LCA ranks as number 10 of 140 journals in the environmental section, thus elucidating how quickly articles are cited in this journal.

Impact factors and number of citations counted by ISI (based only on journals accepted by ISI citation index, no books, reports, etc. are included) are used in many personal and institutional evaluations. Therefore, there is an enormous pressure to publish in journals with a high impact factor, which is a disadvantage for young journals and journals published in languages other than English. The development away from the 'universal' (i.e. European) language Latin, which started in the 17th Century, has now been reversed: back to English, the Latin of our time.

5 How to Prepare a Manuscript: The question of technical quail

5.1 General aspects

5.1.1 Conciseness

First, scientific (in the sense of natural or exact sciences) publications in journals have to be **concise**. This is in sharp contrast to most articles written in the social sciences, philosophy, political sciences, in English mostly summed up as 'social sciences and humanities'. The latter often use long word-by-word quotations, lengthy definitions, etc. This is clearly not acceptable in science and, to me, LCA belongs to science, albeit with some cautionary restrictions which have been mentioned in Section 3.

Conciseness and size of a paper is related, but not identical. A very long and fruitful scientific work may be written concisely, but still be too long to fit into the frame of an ordinary journal. Splitting into several papers is the most frequent solution; since it increases the number of papers published without

Table 1: Since 2001 Int J LCA has been listed in the Citation Index Expanded. The first Impact Factor as of 1.035 was calculated in 2003 (and published in JCR in 2004). The second Impact Factor as of 1.068 was calculated in 2004 (published in JCR in 2005), and the third Impact Factor as of 1.483 was calculated in 2005 and published in JCR in 2006

Int J LCA, Impact Factor as of 2004 (published in JCR in 2005)			Int J LCA, Impact Factor as of 2005 (published in JCR in 2006)		
Cites in 2004 to articles published in:	2003	42	Cites in 2005 to articles published in:	2004	72
Cites in 2004 to articles published in:	2002	52	Cites in 2005 to articles published in:	2003	60
Sum		94	Sum		132
Number of articles published in	2003	46	Number of articles published in:	2004	43
Number of articles published in:	2002	42	Number of articles published in:	2003	46
Sum:		88	Sum:		89
Calculation:			Calculation:		
Cites to articles published in:	2003 + 2002	94	Cites to articles published in:	2004 + 2003	132
Number of articles published in:	2003 + 2002	88	Number of articles published in:	2004 + 2003	89
Impact Factor (Ratio 94 : 88)		1.068	Impact Factor (Ratio 132 : 89)		1.483

– Int J LCA (2005): IF = 1.483 (published in 2006)
 – J Cleaner Production (2005): IF = 0.832 (published in 2006)
 – J Industrial Ecology: IF not before 2008 (to be published in 2009)
 – IEAM: to be reviewed for coverage in the Science Citation Index Expanded

double publication, this solution is popular; however, chopping a work into too many small pieces is not serious either.

5.1.2 Language

In choosing the best language, the intended auditory is decisive. If this is international/global, only English is acceptable. A native speaker should read and improve the manuscript if the author is not a native speaker. This service is offered by ecomed for a moderate charge. Case studies which are relevant for one country only can and should be published in the national language, and thus in national journals, especially if, in the country concerned, not all potential readers and decision makers are fluent in English. This seems to be the case in many countries. What is true for local authorities and small companies is certainly not true for international companies and organisations: these have to be addressed in English and, in certain regions, in French or Spanish.

5.1.3 Help

There are books on scientific writing which should be consulted. Perhaps equally good or better are examples: excellent papers from one's own fields. Not only the text itself is important, but also the figures and tables, which should not be redundant, but clear and readable.

5.2 Details

5.2.1 Types of papers

There are different types of papers, which are usual in most journals:

- Short contributions (letters)
- Full research papers (methods or case studies)
- Review papers
- Opinion papers (commentaries)
- Further types, in particular in Int J LCA: editorials, letters to the editor, theses summaries, book reviews, conference reports

The size of these papers varies, of course, from a few pages (letters) to quite long in the case of reviews; there are reviews on important topics which may occupy a whole issue (although not in the case of Int J LCA).

Opinion papers make a journal lively and are useful with regard to the critical discussion mentioned in Section 1. Remember: critical discussions should also be written in a non-offensive style.

5.2.2 References

Special attention has to be paid to the references. Most journals require a certain style or they offer variants between quoting by [author(s) + year] and quoting by [consecutive number] in the text. These are the main types, but there are variants in detail which have to be observed.

Beyond these formal aspects, there are aspects of respect and politeness, especially in giving credit to previous work. If a field has a long tradition, some standard books or review articles may give credit to earlier work. With the exception of very new ('emergent') fields of research – even in that case there are frequently precursors – it is intolerable that only very recent papers are cited.

Quoting grey literature is often necessary, especially if the quoted studies give details not available otherwise and if these studies have never been published.

Care should be used in citing websites, since these are often short-lived. Once the website is cancelled or the report quoted removed from it, it is not possible for the reader to check and learn details not disclosed in the original paper.

There is an exception to this rule, namely the DOI numbers of recently published manuscripts. A manuscript with a DOI number (e.g. 'online first' in Int J LCA) is **published and can be cited**. Once the paper has appeared in print, the volume, year and page numbers should be added to the citation. The DOI (Digital Object Identifier) is simultaneously citation code and Internet address of a paper. A paper with a DOI can always, through its entire life cycle, be retrieved via this address (see section 6.2).

5.2.3 Guidelines

It may sound trivial, but it happens that the guidelines for authors are not read by the authors. These detailed instructions can now be found at the websites of the journals. Int J LCA refuses to accept manuscripts not in accordance with its guidelines. The guidelines of this journal recently changed, due to the transition from E-mail submission to electronic submission (ESS) in January 2006. E-mail submission is still used, but only for non-reviewed papers.

6 Submission of papers and the Peer Review Process

6.1 Formal process

The details in this section refer specifically to Int J LCA, but the general remarks on peer reviewing are also valid for other journals.

Since 1st of January 2006, submission occurs via the Electronic Submission System (ESS: <http://www.scientificjournals.co/sj/all/EES>) [14]. Details about this process can be found in the guidance for authors at the website of Int J LCA (<http://www.scientificjournals.com/lca>) or directly called up (<http://www.scientificjournals.com/sj/pdf/lca/authorGuidelines.pdf>).

The author is asked to submit an abstract that follows a specific structure presented by a template in the ESS. Once the abstract has been reviewed for technical and scientific requirements, the Submission Editor supervises the review process. He/she invites and reviews the manuscript, invites two to three referees, is responsible for a straight forward review process, examines the review comments as well as the itemized replies of the author, and reviews the revised version.

The whole process can be observed by both the Editor-in-Chief and the Publisher-Editor via ESS. The ESS automatically notifies the different actors to check the system when a new state in the life cycle of the paper has been reached or comments from the co-players have arrived.

6.2 Refereeing and publication

The referees are anonymous; however, they can offer to directly discuss with the corresponding author the comments.

It is up to the corresponding author whether or not this offer is accepted. If accepted, it may lead to a longer exchange of ideas and manuscripts. Anonymity is a protection for the referee, which, however, should not be misused. The referees are asked to formulate any criticism in a polite and non-offensive form.

After having received the review comments, the author is requested to submit an 'Itemized Reply' to each review, i.e. to respond to the individual comments item by item in order to explain in which way he/she plans to handle the recommendations or where he/she may not be able to conform with the statements. Thereupon, the Submission Editor invites the author to submit the revised version.

It is then up to the referees to accept the revised paper, or to accept it with modifications, or to reject it. In most cases, the Submission Editor would follow the advice of the referees, but this is not a MUST. The final decision in controversial cases is taken by the Submission Editor who, in such cases, would consult the Editor-in-Chief.

If the revised manuscript is accepted by the Submission Editor/Editor-in-Chief, the manuscript goes into production (language control, formatting, setting, proofing). When the author correction (proof reading) has been performed, the Publisher-Editor transfers the paper into the Online-First section of the website. From this moment, the paper can be cited with the DOI number, and this is a paradigm. Authors need no longer wait for the publication in the printed edition in order to cite his/her paper. Therefore, the Online-First publication is the **official** publication. The appearance in the printed edition of the journal is only an afterthought.

The date of acceptance for online-first is the publication date (this may be relevant in priority questions). The publication in the printed journal follows as soon as possible, but can take some time. The increase to 7 issues per year (starting with Vol. 12, 2007) will help to decrease the back-log, i.e. the papers published online-first but not yet printed. As an additional measure, the number of special issues within the regular edition (frequent in the past) will be limited so that more space is available for the manuscripts submitted in the regular procedure. Special issues will be published outside the regular edition, as in the case of the Helias Udo de Haes special issue in Vol. 11 (2006). In that case, the printing costs have to be paid by the commissioner of the issue who, in turn, gets, for example, 200 or 300 copies of the special issue for free. The same policy applies to the LCA Documents.

6.3 Rejection of manuscripts

If the paper cannot be accepted for publication ('rejected'), the Editor-in-Chief contacts the corresponding author. This belongs to the less enjoyable duties of this, in many ways, very exciting job. I am well aware what this means for the author(s), often after a long and tiring review process. The Editors of Int J LCA try to avoid rejections by critically selecting the abstracts; unfortunately, the abstract says a lot about the topic, but much less about the quality of the full manuscript. Therefore, it has recently been decided that the Submission Editor has the right to reject the manuscript immediately after submission and without opening a peer review process if he/she has come to the firm belief that the

paper would not survive the review process. This will hopefully reduce the number of long-lasting and finally unsatisfactory reviews.

'Accepted only after thorough revision' is no rejection, but it means de facto writing a new paper, or nearly so. A new review team is formed after resubmission of the revised manuscript. Alternatively, the author may prefer to withdraw the manuscript.

7 Multiple Publication

Multiple publication is an ambiguous topic. Of course, multiple publication of the same manuscript is unethical, against the copyright and cannot be tolerated by any serious editor. A concrete case has recently been presented and discussed in a sister journal of Int J LCA [15]. In this editorial, the 'Ethical Guidelines for Publication in Journals and Reviews', as adopted by the European Association for Chemical and Molecular Sciences (EuCheMS), are presented. In these excellent guidelines, which are also relevant for the non-chemical sciences, the responsibilities of the editors (including the members of editorial boards), authors, and referees are clearly described. Furthermore, the following examples of misconduct are given and defined: fraud, duplicate submission, duplicate publication, inadequate citing, plagiarism, and self-plagiarism. The state of the discussion in the USA from the point of view of the editors has been presented by WG Schultz [16].

If a certain overlap in the content of two or more papers cannot be avoided, a situation which is frequently observed, the copyright-holder has to be asked for allowance to use a part of the previous publication, in most cases one or more figures. The permission is mostly granted, if the origin is clearly acknowledged. It is interesting to note that translation into another language (mostly from English into a national language) is not considered as a duplicate publication if full credit is given to the original paper and, of course, if the copyright-holder agrees⁷.

Submission of a rejected manuscript to another journal does not constitute a duplicate submission. It is a good idea, however, to improve the manuscript, taking into account the commentaries of the original referees as far as possible. Submission of a non-improved, rejected manuscript may lead to another rejection. The publisher of the second journal should be informed about the history of the manuscript. He or she should not learn of it from a third party, since this will make a very bad impression. Honesty pays.

It is often said that, 'The world is small', but this is not true: the pool in which we are swimming is small. Many editorial board members also belong to the board of other journals or occasionally work for other journals. The editors know each other and LCA/LCM is still a relatively small field. This is why even the milder forms of misconduct are often detected soon.

The reason for changing the journal for publication can be really harmless and formal. Since Int J LCA does not accept very long manuscripts, some authors go to J Ind Ecol. We recently received an excellent, but much too long, manuscript.

⁷ Agreements about contracts always require the written form.

After discussing this issue with the Publisher-Editor, it was suggested to split the manuscript into two or three parts, but this was not accepted by the corresponding author. As a consequence, the paper was submitted, accepted and published by *J Ind Ecol*. There is nothing wrong with this and, of course, it has nothing to do with double publication.

Most cases are solved in a collegial way. There is one general exception, however, if the editor(s) get the impression that the author is trying to cheat. This impression or suspicion can arise from seemingly innocent observations. Most authors cite their own recent papers. If a reference to a similar, recently published paper is missing, suspicion may arise that the fact of a previous publication should be hidden. If this happens to my journal, I have to do detective work: reading the previous article, comparing with the manuscript submitted and finally deciding whether or not there is enough new information to justify another publication. I try to be fair, since I know that the pressure of 'publish or perish' is high in academia (in sharp contrast to industry, where such a pressure is absent).

8 Résumé

In the introduction, a short survey of scientific publishing in general has been given. There is convincing evidence that publication is not a tedious piece of work that has to be done at the end of a research work, diploma or PhD thesis, etc. It is rather a central point of the scientific enterprise:

- Without publication no critical discussion
- Without critical discussion no modern science.

And, of course, it is an important step in an academic career, but this aspect is so very well known and even overestimated in our time of formal evaluations. A few very good papers would be better than a long list of average quality.

Also, the next point, choosing the journal according to the intended audience, is made difficult, at least in academia, by the requirement of impact factors. Especially in the case of LCA and LCM, it would often be better to publish convincing case and success stories in journals read by decision makers in the relevant industry sector, in order to learn more about the applications of LCA. But these journals often are not accepted by ISI and, therefore, cannot get an impact factor.

Concrete advice in publishing a paper can be summarized as follows:

- If the journal of first choice is identified, study carefully the website of this journal, especially the guidance for authors, list of editorial board members, look for related papers (key-word index) which may have escaped your attention
- Don't only cite the related papers, but discuss them shortly and show what is new in your approach in relation to the existing knowledge
- LCA is an applied science, progress can also consist in making the method more applicable and perhaps simpler. This is a very relevant point in LCIA, many new indicator models are either not used or used – without thinking – as part of software systems.

At this point, I would like to insert my credo that the best use which can be made by LCA is learning; this may (and should) ultimately lead to better decisions with regard to the environment.

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Further Reading:

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- Suh S (2006): Cultivating a healthy journal space. *Int J LCA* 11 (2) 77–79